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OVERLAP IN THE DIETS OF DIURNAL RAPTORS BREEDING AT THE MICHILÍA BIOSPHERE RESERVE, DURANGO, MEXICO

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ABSTRACT.—We studied the diets of the Turkey Vulture (*Cathartes aura*), Black Hawk (*Buteogallus anthracinus*), Zone-tailed Hawk (*Buteo albonotatus*), Red-tailed Hawk (*B. jamaicensis*), Cooper's Hawk (*Accipiter cooperii*) and American Kestrel (*Falco sparverius*) by examining pellets collected during 1981 and 1982 breeding seasons in the reserve of La Michilía, Durango, Mexico.

Diet overlap was small. The Turkey Vulture and the Black Hawk had little overlap by feeding on restricted types of food (carrion and fish). Hawks (*Buteo* and *Accipiter*) ate prey of similar types and sizes but hunted in different habitats and captured different species. The American Kestrel ate the same prey as the Red-tailed Hawk but selected younger and smaller individuals.

Solapamiento en las dietas de aves rapaces, en la estación reproductora, en la reserva de la Michilía, Durango, México

EXTRACTO.—Se estudia la alimentación de 6 especies de rapaces: Aura Común (*Cathartes aura*), Aguililla Negra (*Buteogallus anthracinus*), Aguililla Aura (*Buteo albonotatus*), Aguililla Colirroja (*B. jamaicensis*), Gavilán Pechirrufo Mayor (*Accipiter cooperii*) y Halcón Cernícalo (*Falco sparverius*), nidificantes en la reserva de La Michilía, en base a egagrópilas recolectadas durante la estación reproductora (abril-agosto) en 1981 y 1982.

El solapamiento entre las distintas dietas es muy pequeño. La selección de tipos particulares de alimento (carroña y peces) hace que *C. aura* y *B. anthracinus* no solapen entre sí ni con otras especies. Las dos aguililas y *A. cooperii,* aunque capturan presas de tipo y tamaño muy similar, solapan poco sus dietas por cazar en hábitats distintos. *F. sparverius* tiene una dieta similar a *B. jamaicensis* a nivel de especies pero se segrega capturando individuos jóvenes de menor tamaño.

Feeding habits of North American raptors are in general well known in the United States and in Canada, but information is lacking for most of the species in Mexico (Palmer 1988). In the reserve of La Michilía located in the oak-pine forests of the western Sierra Madre, seven species of diurnal raptors breed: Turkey Vulture *Cathartes aura,* Black Hawk *Buteogallus anthracinus,* Zone-tailed Hawk *Buteo albonotatus,* Red-tailed Hawk *B. jamaicensis,* Cooper's Hawk *Accipiter cooperii*, Sharp-shinned Hawk *A. striatus* and American Kestrel *Falco sparverius*. We studied their diets except that of Sharp-shinned Hawk during the breeding season.

STUDY AREA AND METHODS

The study was done in the Biosphere Reserve of La Michilía, in the Mexican State of Durango (23°27'N 104°18'W). Located in a transition zone ranging from high mountains to plateaus, the reserve has an average altitude of 2250 m and is an irregular high plain between two mountain ranges, the Sierras of Urica and Michis. Climate

Table 1. Prey species identified in raptor pellets, during the breeding season at the reserve of La Michilía, Durango, Mexico. Percent biomass is represented in parentheses.

	Turkey Vulture	Cooper's Hawk	Black Hawk	Zone-tailed Hawk	Red-tailed Hawk	American Kestrel
Fruits	2 (<1%)	0	0	0	0	0
Invertebrates	4 (<1%)	0	14 (2%)	0	5 (<1%)	159 (17%)
Fish	0	0	56 (86%)	0	0	0
Moxostoma austrinum						
Amphibians	0	0	6 (2%)	1 (<1%)	0	0
Reptiles	3 (12%)	52 (21%)	6 (10%)	85 (19%)	5 (1%)	35 (18%)
Sceloporus jarrovi	0	0	5	14	1	2
Sceloporus poinsetti	0	20	0	68	0	4
Sceloporus grammicus	0	1	0	1	0	1
Sceloporus scalaris	0	0	0	0	0	23
Sceloporus sp.	0	8	1	2	2	3
Phrynosoma orbiculare	0	22	0	0	1	0
Barisia imbricata	0	1	0	0	0	1
Eumeces brevirostris	0	0	0	0	1	1
Unidentified snakes	3	0	0	0	0	0
Birds	2 (1%)	99 (54%)	0	67 (38%)	3 (4%)	8 (16%)
Columba fasciata	0	0	0	0	2	0
Junco phaoenotus	0	9	0	0	0	0
Colaptes cafer	0	20	0	17	0	0
Melanerpes formicivorus	0	1	0	8	0	0
Other Picidae	0	5	0	4	0	0
Sialia mexicana	2	7	0	1	0	0
Spinus spp.	0	3	0	0	0	0
Piranga spp.	0	10	0	0	0	0
Aphelocoma spp.	0	1	0	3	0	0
Pipilo erythrophthalmus	0	2	0	0	0	0
Turdus migratorius	0	4	0	3	0	0
Oriturus spp.	0	2	0	0	0	0
Euptilotis neoxenus	0	1	0	1	0	0
Cianocitta stelleri	0	0	0	2	0	0
Otus asio	0	0	0	4	0	0
Lanius ludovicianus	0	0	0	0	0	1
Unidentified birds	0	34	0	24	1	7
Mammals	20 (29%)	40 (25%)	0	63 (43%)	90 (92%)	24 (50%)
Reithrodontomys spp.	0	0	0	0	1	0
Peromyscus sp.	0	0	0	2	5	2
Sigmodon fulviventer	20	0	0	15	83	18
Sigmodon leucotis	0	11	0	15	0	0
Sigmodon sp.	0	0	0	21	0	0
Other small mammals	0	11	0	5	0	4
Eutamias bulleri	0	6	0	5	0	0

Table 1. Continued.

	TURKEY VULTURE	COOPER'S HAWK	BLACK HAWK	ZONE-TAILED HAWK	RED-TAILED HAWK	AMERICAN KESTREL
Sylvilagus floridanus	0	9	0	0	1	0
Unidentified mammals	0	3	0	0	0	0
Carrion	29 (58%)	0	0	0	1 (2%)	0
Pigs and *Odocoileus virginianus*	29				1	

is semiarid with summer rains (600 mm per year) and an annual mean temperature of 19°C (Gallina 1981). Vegetation is dominated by oak-pine forests (*Quercus* sp., *Pinus* sp.) with local patches of juniper (*Juniperus* sp.), manzanita thickets (*Arctostaphylos* sp.) and open grasslands. Our study was based on pellets collected near the nests and under perches habitually used by adults, during 1981 and 1982 breeding seasons (from April to August). We identified prey remains in pellets with the help of prey specimens previously collected in the study area, and collections kept at the Zoology Department of the U.A.M. Iztapalapa (Mexico D.F.). When possible, the minimum number of individuals of each prey-species in each pellet was recorded. If this was not possible, each prey occurrence in one pellet was considered to be one individual. Most prey weights were obtained from individuals caught in the area; however, for a few species weights were obtained from field guides (Burt and Grossenheider 1976). Weights for different size categories for some prey species were used. For estimating biomass of large prey species a maximum ingestion capacity, based on their body size, was considered for some raptor species: 180 g for Red-tailed Hawk, 100 g for Zone-tailed Hawk, 80 g for Cooper's Hawk and 33 g for American Kestrel. Food consumption at a carcass was estimated as 350 g for the Turkey Vulture based on our observations (Hernández et al. 1987). Whenever a prey was heavier, its contribution in biomass to the diet was considered equivalent to the maximum ingestion capacity of the raptor species. We used Pianka's index (Pianka 1973) on biomass contribution of each prey species grouped in systematic prey type categories and on frequency of occurrence in prey size categories to estimate diet overlap.

RESULTS AND DISCUSSION

Diet. Prey found in each species' pellets and biomass contribution to the diet of the systematic prey categories considered for each raptor are listed in Table 1. Figure 1 shows number of captures in each prey size category.

The Black Hawk ate mainly fish, although invertebrates, amphibians and some reptiles were occasionally caught. The American Kestrel ate mainly small mammals, reptiles and insects, while the Red-tailed Hawk ate mainly small mammals. The diets of the American Kestrel and Red-tailed Hawk were similar to those recorded in other parts of North America (Brown and Amadon 1968). Information on the diet of the Zone-tailed Hawk is limited (Palmer 1988, Hiraldo et al. 1989). Our results show that this hawk is a more active hunter than other species of the genus *Buteo,* based upon the proportion of fast and elusive prey (e.g., birds) in the diet. The Cooper's Hawk captured more reptiles in our study area than in most of its range in North America. This could be a local habit in an area where forest reptiles are abundant as in La Michilía (Ortega et al. 1982). Similar proportions of reptiles were found in the diet of Cooper's Hawk in a California study area (Fitch et al. 1946) where reptiles were also abundant. The Turkey Vulture, which is usually a scavenger of small vertebrates, fed mainly on carcasses of medium and large mammals in La Michilía. The Turkey Vulture took the role of the Black Vulture (*Coragyps atratus*) in this area. Although the Black Vulture, which is more efficient than the Turkey Vulture at exploiting large carcasses (Hiraldo, Delibes and Donázar, in press), was present only 20 km from La Michilía, we never saw Black Vultures in the study area.

Diet Overlap. The Turkey Vulture and the Black Hawk had little overlap in their diets or with those of other raptor species as they feed on restricted types of food, carrion and fish respectively. Diet overlap occurred among the Cooper's Hawk, the Zone-tailed Hawk, the Red-tailed Hawk and the American Kestrel if we consider systematic categories of prey (Table 2). If size of prey is considered, the American Kestrel is eliminated from the overlap group. The cotton rats (*Sigmodon* spp.) captured by kestrels were all young individuals (<26 g) while the other raptors captured almost always adult rats. In addition, Cooper's, Zone-tailed and Red-tailed Hawks segregated themselves according to habitat when look-

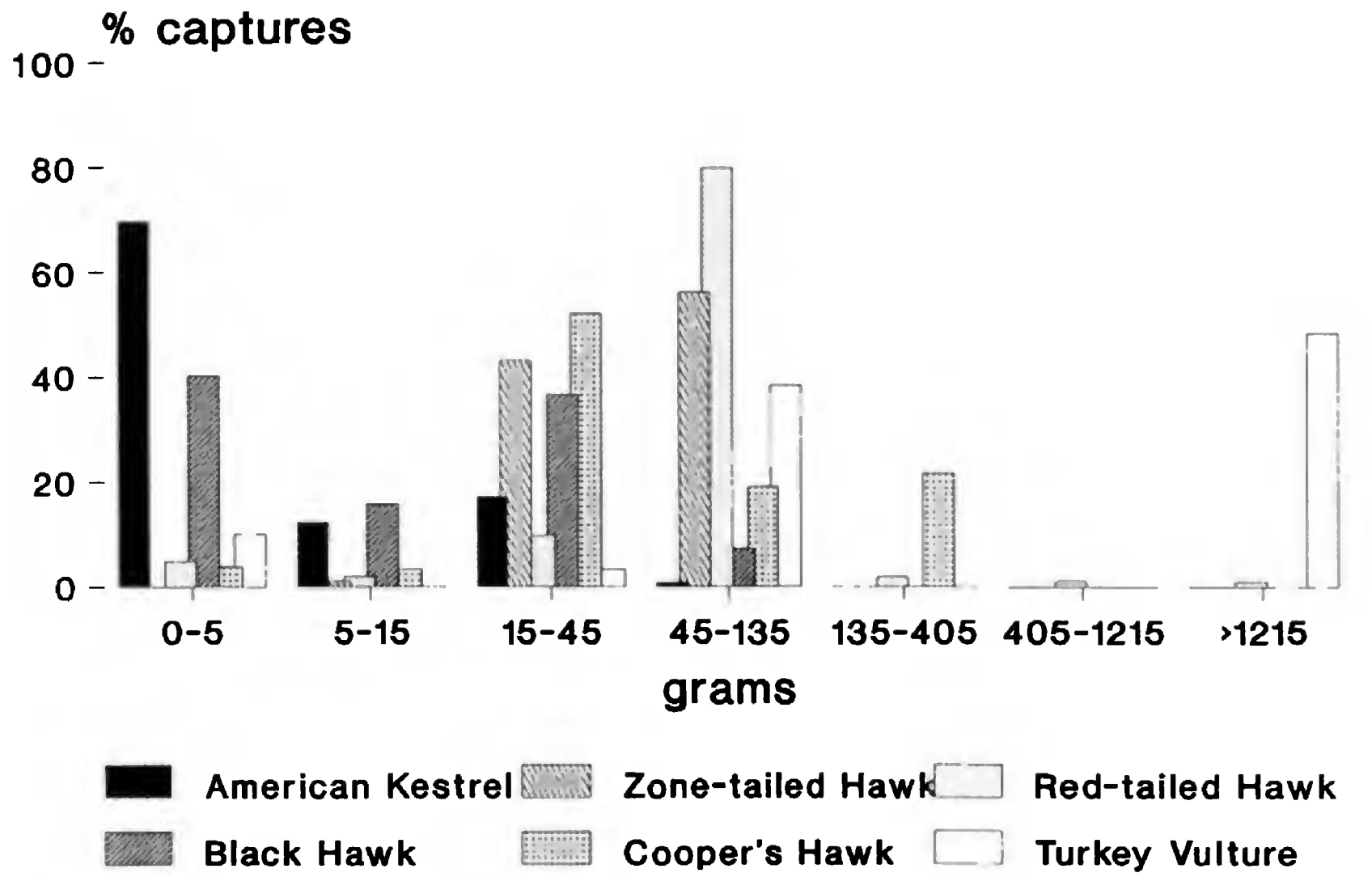

Figure 1. Percentage of prey of different size classes captured by raptors at the reserve of La Michilía, Durango, Mexico.

ing for food. Forest dwelling species were captured almost exclusively by the Cooper's Hawk. The forest lizard *Phrynosoma orbiculare* was seldom caught by other hawks, but appeared frequently in the pellets of Cooper's Hawks. Cooper's Hawks also fed exclusively on the forest dwelling *Sigmodon leucotis*. Red-tailed Hawks hunted in open areas catching exclusively *S. fulviventer,* while the Zone-tailed Hawk seemed to prefer forest borders and forest clearings and caught both species of cotton rat.

The community of breeding raptors studied in La Michilía seems to have a reduced diet overlap among its members, if we compare it to other communities (Herrera and Hiraldo 1976, Jaksić and Braker 1983). This low overlap may be due to the reduced number of raptor species. La Michilía, located between the

Table 2. Values of Pianka's (1973) overlap index according to biomass contribution of different systematic prey classes (those bold in Table 1). For those species with biomass overlap values higher than 0.5, Pianka's index has been estimated also for the number of prey of different size classes, and this is represented in parentheses.

	Cooper's Hawk	Black Hawk	Zone-tailed Hawk	Red-tailed Hawk	American Kestrel
Turkey Vulture	0.098	0.009	0.156	0.208	0.183
Cooper's Hawk		0.038	0.924	0.436	0.680
			(0.782)	(0.266)	(0.278)
Black Hawk			0.036	0.001	0.043
Zone-tailed Hawk				0.741	0.884
				(0.859)	(0.155)
Red-tailed Hawk					0.876
					(0.101)

deserts (northern Mexico and southwestern United States) and subtropical areas in the south of Mexico, has a community of raptors formed by a reduced sample of temperate and tropical species. The different feeding guilds were represented but only by a reduced number of species. Compared to other tropical and temperate communities of raptors, in La Michilía the reduction in the number of species in the community has been more important than the reduction in the number of feeding guilds.

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